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USSR Report

LIFE SCIENCES

EFFECTS OF NONIONIZING ELECTROMAGNETIC RADIATION

No. 5

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CONTENTS

UDC 616.831.31-085.849.11

PATHOMORPHOLOGICAL REACTIONS OF CEREBROCORTICAL NEURAL ELEMENTS TO ALTERNATING MAGNETIC FIELD

Moscow ARKHIV PATOLOGII in Russian Vol 43, No 11, Nov 81
(manuscript received 13 Apr 81) pp 33-36

[Article by I. V. Toroptsev and L. P. Soldatova, Department of Pathological Anatomy and Department of Histology and Embryology of the Tomsk Medical Institute]

[Text] The specific action of magnetic fields has not been determined yet (3-7); our attempt at discovering reactions to such fields motivated us to study the cerebral cortex as a model highly sensitive to magnetic fields. In addition to nonspecific action, we discovered significant disturbances in the water-electrolyte balance, manifested as hydropic changes in the walls of cortical capillaries, nerve cells and their derivatives.

The magnetic field source we used was a horseshoe electromagnet with trapezoidal tips at the poles. The dimensions of its working surface were 120×280×190 mm, and the gap between the poles was 80 mm. The electromagnet was used to create an alternating magnetic field with a frequency of 50 Hz, which deviated by no more than 5 percent over the entire area of the magnet at a field intensity of 20 mT. The field gradient was 0.1 mT/cm. Intensity pulsation was 1.8 percent. One-time total exposures lasting 6.5 hours were employed. The experiments were run in winter on 136 male rats weighing 190-210 gm. The animals (three specimens in each experiment) were maintained unrestrained in a nonmagnetic cage which limited mobility somewhat. They were killed by decapitation after 1, 6, 12 and 24 hours and 3, 5, 7, 14, 21 and 28 days following exposure. Portions of the parietal, posterior frontal and limbic cortex were sampled as morphological equivalents of, correspondingly, the sensomotor, kinesthetic and motor analyzers and the analyzer of the internal environment. The chunks of tissue were fixed in Carnoy's fluid, absolute alcohol and 12 percent neutral formalin. In addition to the conventional histological methods we used toluidine blue, Nissl, Pishinger (pH 4.2), and Eynarson halocyanin-chromium alum staining. The state of the dendrite system and spicules was studied on preparations impregnated with Golgi stain. Glial macrophages were revealed by the Miyagawa-Aleksandrovskaya method, and astrocytes were revealed by the Kakhal' method. The volume of neurocyte bodies, nuclei and nucleoli was calculated using a formula for an ellipsoid of rotation (2), and the numerical material was subsequently processed with a "Nairi" computer. Significance was determined by the Student-Fisher test.

In the first hours following exposure we revealed signs of disturbed local circulation in cortical vessels, manifested as vacuolization of the cytoplasm and swelling

of the nuclei of some endotheliocytes, as separation of the basal layer into separate fibers and as pericapillary edema. The architectonics of the parietal cortex and of the zone covering the internal analyzers were not disturbed. Chromatolysis and vacuolization are the most frequent changes in neurocytes. Chromatolysis may vary in degree--from insignificant clarification of cells to segmental and total absence of concentrations of basophilic substance. Damage to structural proteins and lipoids in cells elicits change in cell membrane permeability, which is accompanied by disturbance of the cell's water-salt balance. Owing to this chromatolysis in some of the neurocytes is combined with hydrophic changes, expressed as vacuolization and edema (see figure, *a*,*b* [figure not reproduced]) accompanied by an increase in the volume of nerve cell bodies and nuclei (see table). Vacuolization in small and medium-sized pyramidal neurocytes usually manifests itself as large cavities, while numerous small vacuoles are most typical of large pyramidal neurocytes. Hyperchromic neurocytes are also encountered (see figure, *d*). Both chromatolysis and hyperchromatosis occur together with different degrees of vacuolization. These signs form in the course of the first 3 days, terminating in some cases with the appearance of ghost cells and neuronophages (see figure, *e*, *f*). The observed changes are severe and irreversible (1). Almost complete absence of spicules is typical of many dendrites early in the period of observation. Dendrites cannot be traced very far from the cell body, dyschromia and swelling are typical, and swellings and vacuoles are clearly evident. The reaction of gliocytes is variable: The concentration of free and perineuronal oligodendrites and gliomacrophages is noticeably reduced in the superficial and profound layers of the cortex. The nuclei of free gliocytes are often vacuolated. The occurrence of fibrous astrocytes in profound cortical layers usually remains the same. However, many astrocytes possess swollen, sometimes fragmerted processes.

After 5-7 days chromatolysis and hydropic changes persisting in some of the cells are accompanied by compensatory-adaptive reactions that manifest themselves as hypertrophy of the nucleolus and appearance of clumps of chromatin by the nuclear membrane (see figure, *c*). Proliferation and hypertrophy of fibrous astrocytes are observed, and oligodendrogliocytes and glial macrophages are revealed more frequently. Fourteen to 21 days after exposure to the field a tendency toward normalization of the structure of neurocytes and glial elements due to intracellular regeneration is noticeable. Investigation of interneuronal associations showed that the concentration of spicules grows noticeably on portions of dendrites that do not experience visible deformation, especially in areas close to the perikaryon. However, vacuolization and dyschromic phenomena still persist in some fields of vision. By the end of the maximum period of observation (28 days) most neural elements of the divisions of the brain we analyzed do not differ from controls. Nageotte nodes can be seen at the sites of dead nerve cells.

Conclusion

Phenomena we revealed in response to exposure to an alternating magnetic field included disturbances in microcirculation, changes in the communication system of neurocytes and significant reactions by glial elements of the cortex.

Vacuolization of the perikaryon of neurocytes and of the nuclei of oligodendrogliocytes, hydropic changes in the cellular and fibrous components of the vascular wall

Nuclear-Cytoplasmic Ratios in Small and Medium-Sized Pyramidal Neurocytes of Layers III, V and VI of the Parietal Cortex of Albino Rats Following One-Time 6.5-Hour Exposure to a 20 mT, 50 Hz Alternating Magnetic Field

(1) Срок наблюдения	(2) Серия исследований	Объем, единицы окуляр-микрометра (3) перикарион (4) $M \pm m$	P	ядра (5) $M \pm m$	P	ядрышки (6) $M \pm m$	P
(7) 1 ч	О	6,14±0,46	<0,01	0,89±0,04	<0,001	0,054±0,0018	<0,01
	К	4,82±0,33		0,56±0,06		0,021±0,0024	
6 ч	О	6,17±0,42	<0,01	0,83±0,07	<0,001	0,058±0,0016	<0,001
	К	4,49±0,26		0,51±0,08		0,024±0,0027	
12 ч	О	5,92±0,31	<0,01	0,81±0,05	<0,02	0,047±0,0035	<0,01
	К	4,16±0,55		0,62±0,03		0,026±0,0042	
(8) 1 сут	О	6,01±0,66	<0,01	0,76±0,07	<0,02	0,046±0,0043	<0,02
	К	4,24±0,38		0,54±0,06		0,028±0,0017	
3 сут	О	5,89±0,47	0,01	0,77±0,05	0,05	0,047±0,027	0,05
	К	4,87±0,44		0,61±0,08		0,029±0,0045	
5 сут	О	5,98±0,63	0,05	0,77±0,04	0,05	0,036±0,0027	0,05
	К	4,64±0,42		0,59±0,06		0,027±0,0034	
7 сут	О	4,92±0,41	>0,02	0,62±0,04	>0,05	0,029±0,0072	>0,05
	К	4,51±0,73		0,70±0,03		0,026±0,0044	
14 сут	О	4,69±0,53	>0,05	0,74±0,02	>0,05	0,024±0,0018	>0,05
	К	4,37±0,45		0,68±0,04		0,023±0,0023	
21 сут	О	4,89±0,74	>0,05	0,61±0,04	>0,05	0,029±0,0028	>0,05
	К	5,02±0,67		0,69±0,06		0,027±0,0035	
28 сут	О	4,77±0,82	>0,05	0,72±0,07	>0,05	0,019±0,0026	>0,05
	К	4,99±0,43		0,68±0,06		0,029±0,0041	

Note: O--Experimental series, K--control.

Key:

1. Time of observation
2. Research series
3. Volume in units of an ocular micrometer
4. Perikaryon
5. Nucleus
6. Nucleolus
7. Hours
8. Days

and presence of vacuoles in dendrites, which reach their peak in the first 5 days, attest to disturbances in the water-salt balance of cells and a tendency for edema in brain tissue. Magnetic fields probably exert their influence by way of hydropic changes at the cellular level.

BIBLIOGRAPHY

1. Popova, E. N., Lapin, S. K. and Krivitskaya, G. N., "Morfologiya prisposobitel'nykh izmeneniy nervnykh struktur" [Morphology of Adaptive Changes in Nervous Structures], Moscow, 1976.

2. Tashke, K., "Vvedeniye v kolichestvennuyu tsitogistologicheskuyu morfologiyu" [Introduction to Quantitative Cytohistological Morphology], Bucharest, 1980.

3. Kholodov, Yu. A., "Reaktsiya nervnoy sistemy na elektromagintnoye pole" [Reaction of the Nervous System to an Electromagnetic Field], Moscow, 1975.

4. Kholodov, Yu. A. and Shishlo, M. A., "Elektromagnitnyye polya v neyrofiziologii" [Electromagnetic Fields in Neurophysiology], Moscow, 1979.

5. Adey, W. R., PROC. I.E.E.E., Vol 68, 1980, pp 119-125.

6. Cope, Freeman W., PHYSIOL. CHEM. AND PHYS., Vol 11, 1979, pp 461-463.

7. Thomas, I. R., Find, E. D., Fuek, D. V. et al., ANN. N.Y. ACAD. SCI., Vol 247, 1975, pp 425-432.

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METABOLIC CHANGES IN EXPERIMENTAL ANIMALS AS INDICATORS OF BIOLOGICAL EFFECTS OF 50 HZ ELECTROMAGNETIC FIELDS

Kiev VRACHEBNOYE DELO in Russian No 7, Jul 81 (manuscript received 9 Feb 81) pp 98-100

[Article by L. A. Tomashevskaya and Yu. D. Dumanskiy, Kiev Scientific Research Institute of General and Communal Hygiene imeni A. N. Marzeyev]

[Text] Because of the broad use of energy of commercial frequency (50 Hz) electromagnetic fields (EMF) in the national economy, particularly for transmission of electric power over long distances, and the dense network of high-voltage power lines large groups of people in populated areas are exposed to electromagnetic factors in the industrial environment. For this reason, questions dealing with the nature of effects of EMF on the body and hygienic regulation thereof are quite timely.

However, questions related to the distinctions of biological effects of such EMF as related to different intensities and time modes (Ye. V. Prokhvatilo, 1977; M. G. Shandala, Yu. D. Dumanskiy, 1977) remain open for researchers to this time.

Our objective here was to determine the biological effects of CF [commercial] EMF (according to metabolic processes) as a function of intensity and time of exposure to the field.

We simulated experimentally conditions proceeding from those that actually prevail in areas where high-voltage lines pass. A chronic experiment was conducted on white rats (180 specimens) divided into groups according to intensity (E--10, 15, 20 kV/m) and modes of exposure to CF EMF (4 and 16 times a day, 5 min per session, to a total of 20 and 80 min).

Biochemical processes were evaluated according to different types of metabolism participating in the body's response to CF EMF. For this purpose, we assayed urea and residual nitrogen in blood serum, blood glucose, liver glycogen, adrenal ascorbic acid, cholinesterase activity, ceruloplasmin content and saturation with transferrin iron of blood serum.

Studies were conducted during exposure to the field for 4 months, as well as in the aftereffect period.

There was no appreciable change in urea level with exposure to fields of 15 and 20 kV/m for 5 min 4 times a day at 2-h intervals for 4 months, as compared to the

base level, fluctuating over the same range as in the control. The same fields, when used 16 times a day at 20-min intervals, elicited an 18% increase in urea content after 1 month of exposure and an average of 30% increase in the next 3 months, as compared to the control.

Residual nitrogen was elevated starting in the second month of exposure to fields with intensities of 15 and 20 kV/m 16 times a day, 5 min at a time (total exposure time 80 min). Thereafter, elevation of residual nitrogen remained on the same level during exposure. The aftereffect period was characterized by normalization of urea and residual nitrogen levels in rat blood serum.

With exposure to a lower intensity --10 kV/m (exposure time 80 min)--there was no change in residual nitrogen content, as compared to the control.

Blood serum residual nitrogen of rats exposed to E of 15 and 20 kV/m for 5 min 4 times a day (total exposure time 20 min) fluctuated in the range of control levels showing no appreciable difference from the latter.

It should be noted that the observed elevation of urea and residual nitrogen in the blood of experimental animals was in the range of the physiological norm, even though it was statistically significant, as compared to the control.

We evaluated carbohydrate metabolism of the experimental animals on the basis of blood glucose and liver glycogen levels. Blood glucose content increased reliably at E = 15 kV/m with total exposure for 80 min, and this increase occurred earlier and was more persistent with E = 20 kV/m.

Concurrently with changes in blood glucose level in animals exposed to CF EMF of 20 kV/m for 5 min at a time, 16 times, there was a decrease in liver glycogen content after 4 months of exposure, to 1170.7±76.3 mg% ($P<0.01$).

Thus, under the influence of CF EMF, there was some impairment of carbohydrate metabolism, as indicated by elevation of blood glucose level and decline of liver glycogen. Apparently, the severity of the changes was related to intensity of the factor with the same exposure time. E of 20 and 15 kV/m with total exposure time of 80 min can be considered effective. Duration of exposure is probably also significant: increase thereof from 20 to 80 min at 20 kV/m led to changes in carbohydrate metabolism.

Analysis of our findings revealed that an electric field of 20 kV/m with total exposure time of 80 min elicited a change in adrenocortical function, which was manifested by a decrease in weight of the adrenals (17.6±0.76 mg, versus 24.3± 1.5 mg in the control) and increase in their ascorbic acid content (329.3±12.5 mg%), as compared to the control group of animals (281.1±10.1 mg%). With exposure to an intensity of 15 kV/m in the same mode, we observed some tendency toward increase in ascorbic acid. The observed changes reverted to normal after 1 month of recovery period, and no reliable differences from the control were demonstrated.

Thus, the reaction of the adrenal cortex to CF EMF of 20 kV/m for 5 min 16 times a day, at 20 min intervals, for 4 months was manifested by increased function. This increase in functional activity of the adrenal cortex is one of the most important adaptation mechanisms when homeostasis is impaired due to CF EMF.

Since there are indications in the literature that electromagnetic fields, including those of commercial frequency, affect cholinergic processes (Ye. V. Prokhvatilo, 1977; Yu. D. Dumanskiy et al., 1977), we deemed it necessary to examine them in our experiment. We used one of the conventional indirect indicators--blood cholinesterase activity. We demonstrated an appreciable change in activity of this enzyme with all tested intensities and total exposure time of 80 min. During the first month of exposure there was an increase in cholinesterase activity and thereafter there was a decrease. The most marked changes were observed with 20 kV/m and 80 min exposure. Normalization of this enzyme was already observed 1 month after discontinuing exposure.

It should be noted that with E = 10 kV/m there was only one statistically reliable increase in cholinesterase activity after exposure for 1 month, which can probably be evaluated as an adaptive reaction. CF EMF of 20 and 15 kV/m, with total exposure for 80 min, elicited a persistent elevation of ceruloplasmin level between the first and fourth months of exposure. Ceruloplasmin activity was normalized 1 month after discontinuing exposure.

With the use of EMF of 20 kV/m for 5 min at a time 16 times a day, we observed a 16% increase in transferrin content after 1 month of exposure and 11% increase after 2 months. In the third month, transferrin activity did not differ from the control ($P>0.05$); after 4 months there was another increase in transferrin content. No reliable difference from the control was demonstrable after the 1-month recovery period.

An elevation of transferrin level was noted in the second and third months of exposure to EMF of 15 kV/m for 5 min 16 times a day. No changes in transferrin activity were noted after 4 months of exposure. With the use of lower field intensity (10 kV/m), there was no appreciable difference in transferrin activity, as compared to the control.

Our results revealed that the changes in the metabolic processes studied were related to the field intensity and exposure time. CF EMF of 20 and 15 kV/m used for 5 min 4 times a day at 2-h intervals and 10 kV/m used for 5 min 16 times a day at 20-min intervals for 4 months had no effect on parameters of metabolic processes.

Thus, prolonged intermittent exposure could have some effect on the organism, the degree of which depends on intensity, total exposure time and frequency of exposure. The levels and modes tested at this stage of our study did not lead to serious disturbances of body functions and systems, and the changes were adaptive in most cases.

BIBLIOGRAPHY

1. Dumanskiy, Yu. D., Popovich, V. M. and Kozyarin, I. P., GIG. I SAN., No 12, 1977, pp 32-36.
2. Prokhvatilo, Ye. V., author abstract of candidatorial dissertation, Kiev, 1977
3. Shandala, M. G. and Dumanskiy, Yu. D., in "Aktual'nyye problemy zashchity ot nizkochastotnykh elektromagnitnykh poley" [Pressing Problems of Protection Against Low-Frequency Electromagnetic Fields], Kiev, "Znaniye," 1977, pp 8-13.

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EFFECTS OF EXPERIMENTAL STATIONARY MAGNETIC FIELD ON METABOLISM OF SOME IONS IN BLOOD AND MYOCARDIUM

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 101, No 1, Jan 81 (manuscript received 31 Jul 80) pp 169-172

[Article by D. D. Tvildiani, T. I. Chlaidze, N. V. Dolidze, L. N. Golashvili and V. A. Chikhladze, Institute of Geophysics, Georgian Academy of Sciences; and Tbilisi State Medical Institute (submitted by A. N. Bakuradze, corresponding member of the Academy, on 30 Jul 80)]

[Text] According to data in the literature, an electromagnetic field of different intensities is biologically active. However, "the primary mechanisms of its action have been virtually unidentified as yet" [1-4].

It is known that the circulatory system is the most sensitive to magnetic fields (MF). It is of great theoretical importance to explain the mechanisms of biological and therapeutic effects of MF on this system [5].

Our objective was to conduct a simultaneous complex study of the effects of a stationary MF (SMF) on EKG parameters and ion (Na, K, Ca, Mg) metabolism in blood serum and myocardial homogenate, since the histomorphological changes in the myocardium and other organs induced by MF were also noted in cases where the initial EKG presented no overt changes [6].

This study was conducted on 60 warm-blooded animals--30 rabbits and 30 guinea pigs.

The EKG was recorded on an Elcar-4 cardiograph in standard leads I, II, III and Cl. The machine was set at standard sensitivity (1 mV = 10 mm). Paper tape was fed at the rate of 50 mm/s (rabbits) and 100 mm/s (guinea pigs). The electrodes were secured to the skin by means of Michel's surgical agraffes (rabbits) to prevent dislocation, and this also helped avoid excessive stimulation of experimental animals. During all of the experiments, the rabbits were immobilized on wooden boards, tying the four limbs with bandages, with the back up. There was no ferromagnetic material in the equipment placed in the MF (tables, boards, etc.).

It was possible to generate a homogeneous MF with relatively high intensity (200 Oe) by means of a solenoid.

In the course of the experiment, we measured the rabbits' rectal temperature (initially and at different stages of the experiment). During the experiment, ambient temperature was kept constant (with an accuracy of 1°C).

After taking the base EKG, the animals were exposed to the SMF for 3 h/day for 10 days. After the 10th exposure, we took EKG's and sacrificed one group of guinea pigs by decapitation on the same day, while the second and third groups were sacrificed 24 and 48 h, respectively, after the last exposure in order to demonstrate the SMF aftereffect. At the time of decapitation, we took blood samples, as well as heart specimens, with adherence to relevant rules, to prepare a homogenate and examine ion metabolism.

Na and K electrolyte content of blood serum was assayed by flame photometry on a PFM unit. Ca was assayed by the method of P. D. Spare and Mg by the thiazole yellow D. D. Spare micromethod, using an SF-4A spectrophotometer.

We took 0.5 g myocardium, eluated it in trisaccharose solution (pH 7), cut it into small pieces and added 10 mℓ buffer, preparing a homogenate in a homogenizer [7]. We then submitted it to filtration and assayed Na, K, Ca and Mg, multiplying the final number by two. The obtained results were compared to those of control experiments.

According to our findings, 3-h exposure of rabbits to SMF elicited a shift of the S-T segment on the EKG, depression of T wave, change in amplitudes of R and S waves in different directions, and after 24 and 48 h a drop of general voltage as well. These changes occurred against the background of change in R-R interval and cardiac rhythm.

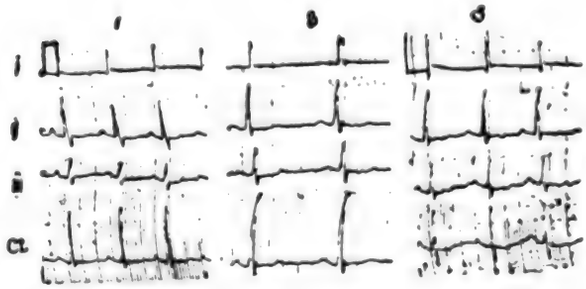

Figure 1.
EKG of guinea pig No 4 in leads I, II, III and C1:
1) base EKG
2, 3) EKG 5 and 24 h after 10-fold exposure to SMF

It should be noted that 13 out of 15 healthy rabbits expired on the 2d-3d day after the last exposure to SMF, although their EKG failed to demonstrate signs of acute myocardial damage.

The guinea pig EKG presented an increase in duration of R-R interval, depression of P and T waves and concurrent change in amplitude of R and S waves, with a shift of S-T segment, particularly in the chest lead (see Figure 1). The EKG parameters reverted essentially to the base levels after 24 and 48 h.

To illustrate the changes in ion content of blood serum and homogenate, we submit graphs (Figures 2 and 3), where the time is plotted on the x-axis--control experiment (C), after discontinuing exposure to SMF (SMF on figure), 24 and 48 h after discontinuing exposure (24, 48); the mean ion (Na, K, Ca, Mg) content in mg% is plotted on the y-axis.

As can be seen, blood serum Na content constituted a mean of 330 mg% in the control group of animals; it increased to 390 mg% after placing experimental animals in the SMF, dropped to 360 mg% after 24 h and again rose to 380 mg% after 48 h.

K content constituted a mean of 29 mg% in the control group, rose to 31 mg% after exposure to SMF and dropped to 27 mg% after termination of the experiment.

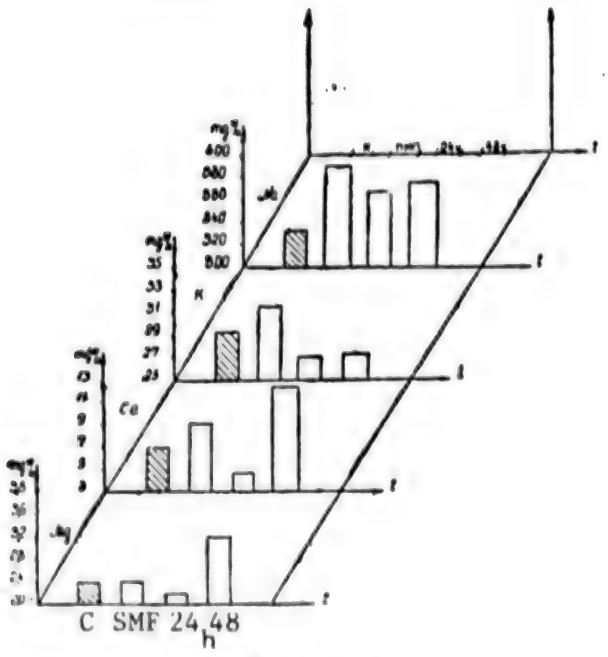

Figure 2.
Ion content of blood serum

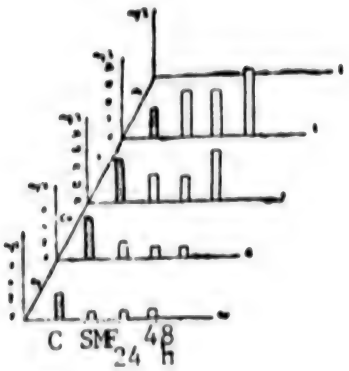

Figure 3.
Ion content of myocardial homogenate

Ca content constituted a mean of 7 mg% in the control group, increasing to 9 mg% after the experiment, then dropping to 5 mg% 24 h after discontinuing exposure to SMF (lower than the control group) and rising again to 12 mg% after 48 h.

In the control group Mg constituted a mean of 2.4 mg%; it did not change after exposure to SMF, dropping to 2.2 mg% 24 h after the experiment and rising to 3.2 mg% after 48 h.

Electrolyte content of the homogenate changed as follows: Na content was 8.82 mg% in the control group, 14.4 mg% after SMF and reached 19.46 mg% after 48 h.

K content constituted 36 mg% in the control group, dropped to 25.6 mg% after exposure to SMF and rose to 39.6 mg% 48 h after the experiment.

Ca content constituted 5.24 mg% in the control group, dropped drastically, to 1.92 mg%, after exposure to SMF, but was close to the control level--3.04 mg%--after 48 h.

Mg content was 3.16 mg% in the control group, dropped to 1.54 mg% after exposure to SMF and constituted 1.54 mg% also 48 h later.

Thus, there was development of specific changes, in the form of change in amplitude, shape and direction of EKG waves (mainly P and T), as well as cardiac rhythm, after repeated exposure of experimental animals to SMF.

Na, K and Ca of blood serum increased under the influence of SMF, while Mg did not change; 24 h after exposure the levels dropped and 48 h after exposure they rose to above control levels.

After exposure of experimental animals to SMF, Na content of the myocardium increased, while K, Ca and Mg decreased. There was a drastic increase in K content 48 h after discontinuing exposure to SMF.

Thus, there is a change in ion equilibrium of blood serum and the myocardium as a result of exposure to high-intensity (up to 200 Oe) SMF.

BIBLIOGRAPHY

1. Aristarkhov, V. M. and Piruzyan, L. A., "Mater. Vsesoyuz. nauch-tekhn. simpoziuma" [Proceedings of All-Union Scientific and Technological Symposium], Moscow, 1975, pp 179-182.

2. Kholodov, Yu. A., PRIRODA, No 4, 1968, pp 114-115.

3. Bessaria, A. and Sabbatino, M., MINERVAS ANAESTESIOLOGICA, 30, 123, 1966.

4. Beischer, D. E., AEROSPACE MED., 35, 10, 1964, p 938.

5. Khanin, M. V. and Zamotayev, I. P., KROVOOBRASHCHENIYE (Yerevan), 11, No 3, 1978, p 14.

6. Tvildiani, D. D., Chlaidze, T. I., Kapanadze, R. V. et al., SOOBSHCHENIYA AN GSSR, 94, No 2, 1979, pp 481-484.

7. Kuksinskiy, V. Ye., KARDIOLOGIYA, No 3, 1978, p 107.

10,657
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EFFECT OF CONSTANT MAGNETIC FIELD ON ELECTROPHYSIOLOGICAL PARAMETERS OF IDENTIFIED NEURONS OF THE SNAIL (HELIX lucorum L.)

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(manuscript received 1 Aug 80, in final form 11 Nov 80) pp 879-884

BRAVARENKO, N. I., BALABAN, P. M. and KUZNETSOV, A. N., Scientific Research Institute for Biological Testing of Chemical Compounds, Kupavna (Moscow Oblast)

[Abstract] This is a continuation of studies of effects of stationary magnetic fields (SMF) on the central nervous system using giant neurons of invertebrates and an intracellular method of recording neuronal activity. The isolated central nervous system of the edible snail (Helix lucorum L.) was used as the object of investigation, using two types of readily identifiable giant neurons: silent neuron of the pleural ganglion RPl1 and spontaneously active neuron of parietal ganglion RPa5. The isolated system was exposed to a magnetic field with induction of 23 mT and heterogeneity not exceeding 0.5 mT/cm, electrophysiological parameters (resting potential of the cell, frequency of spontaneous impulsation, neuronal input resistance) being recorded before, during and after exposure to the field. All of the parameters changed irregularly during the experiment: reduction of spontaneous impulsation in SMF (consistent with results using extracellular derivation of neuronal activity obtained elsewhere), more appreciable change in neuronal input resistance in spontaneously active neurons than in frequency of impulsation, demonstrated for the first time here. The findings referable to the silent neuron are statistically inconclusive. Figures 5; references 4: 1 Russian, 3 Western.
[17-10,657]

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RESULTS OF USING MAGNETIC FIELDS IN OPHTHALMOLOGY

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(manuscript received 15 May 81) pp 321-324

SKRIPKA, V. K., professor, Department of Eye Diseases, Voroshilovgrad Medical Institute

[Abstract] A survey is made of research and advances in use of magnetic fields in ophthalmology, which date back to 1966. Both stationary and variable magnetic fields are in current use, and most ophthalmologists use magnetophores produced by the Leningrad "Sever" Association, which consist of rubber sheets with magnetic filler magnetized so as to have several permanent magnet poles on their surface, and intensity of magnetophores ranges from 160 to 310 Oe. Magnetic applicators are also used. There are some advantages to the use of variable fields, since they involve lower intensities and shorter treatment. Other instruments include the Polyus-1 low-frequency magnetotherapy unit (variable fields) as well as an instrument developed in the Department of Eye Diseases, Voroshilovgrad Medical Institute, for treatment of inflammatory diseases of the eyes, glaucoma and accommodation spasm. Efficacy of variable magnetic fields has been demonstrated in normalizing intraocular pressure in glaucoma patients, enhancement of corneal repair processes following injuries, treatment of herpes of the eyes, keratitis, myopia, inflammatory processes in the anterior vascular tract of the eye (scleritis, iridocyclitis, burns and trauma), amblyopia, as an adjunct in treatment of retinal dystrophy and optic nerve atrophy. The range of applications of magnetotherapy in ophthalmology is constantly increasing, and the main deterrent to broader use thereof is the lack of series-produced equipment to administer it. Because this form of therapy is so promising, continued clinical and experimental research must be pursued to further define indications, dosage, treatment time. References 30 (Russian).
[72-10,657]

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VARIABLE MAGNETIC FIELDS IN TREATMENT OF SOME EYE DISEASES OF VASCULAR GENESIS

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(manuscript received 25 Mar 81) pp 325-328

VAYNSHTEYN, Ye. S., professor, ZOBINA, L. V. and GURTOVAYA, Ye. Ye., senior scientists, Moscow Scientific Research Institute of Eye Diseases imeni Gel'mgol'ts

[Abstract] A study was made of the efficacy of variable magnetic fields, as an adjunct to drug therapy, on thrombosis of the central retinal vein and its

branches, serous choriopathy and atherosclerotic chorioretinal dystrophy, the most serious factor in all of these diseases being microcirculatory disorders of the choroid, as well as edema and detachment of neuroepithelium. Dicinol, trental, prodectin, stugeron, complamine were among agents used to improve circulation, dexamethazone was used to correct edema topically, while diacarb and glyceroascorbate were given by mouth. A total of 77 patients (107 eyes), 18 to 75 years of age, underwent magnetotherapy using low-frequency magnetic fields generated by the series-produced Polyus-1 unit. Treatments lasted 7-10 min, to a total of 10-20 per course, administered daily. There were 32 cases (43 eyes) of central serous choriopathy, 16 cases of thrombosis of central retinal vein branches, 3 cases of thrombosis of this vein and 26 cases of atherosclerotic central chorioretinal dystrophy (45 eyes). Such combined therapy resulted in improvement in 94 eyes, cure in 8, worsening of condition in only 1 case, and no change in 4. Visual acuity also improved in patients suffering from eye pathology of vascular genesis, and levels thereof before and after therapy are tabulated. One case history is submitted. References 9 (Russian). [72-10,657]

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'ELASTOMAGNET' STATIONARY FIELDS USED IN OPHTHALMOLOGICAL PRACTICE

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ZAYKOVA, M. V., professor, GORKUNOV, E. S., candidate of physical and mathematical sciences, KOSHEVOY, V. P., PEREVOZCHIKOVA, P. P., assistants, VENEVTSEVA, Ye. N., OSTANINA, R. A. and ZHAROV, V. V., Physicians, Department of Eye Diseases, Izhevsk Medical Institute

[Abstract] A study was made of efficacy of treatment of eye diseases and trauma with stationary magnetic fields using "elastomagnets" ["magnetoelast"], which is administered in most eye hospitals and ophthalmology departments of regional polyclinics, with determination of indications and contraindications. Elastomagnets are sheets of industrial rubber with highly coercive ferromagnetic particles embedded in it in such a manner as to have the magnetic field change in space perpendicularly to the sheets every 5 mm, from -10 mT to +10 mT. Elastomagnets were used by the authors in various ophthalmological facilities of Udmurtskaya ASSR in 1976-1978 for a total of 2392 patients, in 1831 of whom it was an adjunct to other treatment and 561 the only therapy. The size of the elastomagnets was 5-6 by 4 cm. Treatment consisted of applying them to the closed eyelids for 30-60 min per treatment, the course consisting of 12-45 treatments and 2-3 courses being administered at 2-3 month intervals. The forms of pathology treated included penetrating eye wounds (cornea, sclera, combination thereof), foreign bodies in the eye, contusions, accommodation spasm, myopia, keratitis, uveitis, open angle glaucoma, blepharitis. Visual acuity improved in 47.5% of all cases, did not change in 51.24% and diminished in

1.26%. The only side-effect was headache during treatment in a few cases. Indications and contraindications are given on the basis of analysis of responses to treatment of the above cases. References 22 (Russian). [72-10,657]

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EFFECTS OF STATIONARY AND PULSED MAGNETIC FIELDS ON ULTRASTRUCTURE OF SOME ELEMENTS OF THE EYE

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SKRINNIK, A. V. and DUMBROVA, N. Ye., candidates of medical sciences, Odessa Scientific Research Institute of Eye Diseases and Tissue Therapy imeni Academician V. P. Filatov

[Abstract] Experiments were conducted on rabbits to examine ultrastructural changes in eye tissues elicited by elastomagnet stationary fields (36 mT residual induction, 1-h exposure) and pulsed magnetic fields (magnetic flux density of 3.0 to 17 mT, 15-17 min exposure time) using an original magnetic circuit that provided for uniform magnetic flux density in all media of the eyeball. Pieces of cornea and retina from different parts of the eye were used to prepare ultrafine sections that were stained and examined under an UEMV-100V electron microscope. The anterior corneal epithelium failed to demonstrate reactions to relatively high-intensity stationary fields, while the posterior epithelium presented increased hydration and edema, diminished functional activity progressively growing more severe. Pulsed fields (17 mT) also caused changes in the posterior corneal epithelium and retinal photoreceptors, at lower levels they caused hypertrophy of posterior epithelial cells, increased metabolic activity and permeability (at 8.5 mT), signs of intensification of intracellular processes (at 3-6 mT). Magnetic flux density of 3-8.5 mT was deemed best for treatment of eye diseases with pulsed magnetic fields. These changes must be taken into consideration in deciding on mode of magnetotherapy and the proposed magnetic circuit is helpful. Figures 3; references 2 (Russian). [72-10,657]

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EXPERIMENTAL STUDY OF EFFECTS OF MAGNETIC FIELDS AND CHOLINERGIC AGENTS ON INTRAOCULAR PRESSURE

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KOMISSAROV, I. V., professor, DESNITSKAYA, M. M., professor, and CHESNOKOVA, L. N., assistant, departments of pharmacology of Donetsk and Kalinin Medical Institutes

[Abstract] Experiments were conducted on 400 rats, 500 mice, 60 rabbits and 100 frogs to test the effects of cholinergic agents after exposure to magnetic fields (800 Oe, 30 min exposure, stationary heterogeneous field). There was significant attenuation of effects of such agents (toxicity, specific cholinomimetic activity) with use of magnetic fields. Additional experiments were conducted on an isolated organ (strip of rat stomach, rabbit eye) to determine the cause of this attenuation. In the case of the stomach strip, there was no appreciable change in inherent cholinomimetic and M-cholinolytic reactions after exposure to magnetic field. After exposing the rabbit head to 0.08 T magnetic field for 30 min, instillation of pilocarpine elicited a hypotensive effect on intraocular pressure that was more marked than in intact rabbits, i.e., this agent can be used to lower prossure that was elevated under the influence of the magnetic field. Atropine did not have a pressor effect on "magnetized" animals. The causes of elevation of intraocular pressure in rabbits exposed to magnetic fields could be attributable to neurohumoral and enzymatic changes, as well as greater release of ACTH and cholinesterase activity. Figures 1; references 8: 3 Russian, 5 Western.
[72-10,657]

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